The Data Fusion between Acousto Ultrasonic-Echo (AU-E) and Thermal Measurments for Determining Refractory Thickness and Condition in Operating Furnaces: PART II - Thermomechanical Measurements

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The hearth performance is key to the overall furnace campaign life. The refractory in a furnace hearth is in an arduous environment during operation, experiencing chemical and physical degradation. The furnace hearth experiences high temperatures, erosion due to fluid flow, thermal stress, chemical attack, and steam oxidation. High temperatures and fluctuations cause movements in the form of thermal expansions and contractions throughout the life of the hearth. These, if not properly accounted for, can result in brick crushing or cracking, or gap formation leading to wear zones by rendering cooling system effectiveness. Therefore, detailed understanding of the hearth behaviors by accounting for multidimensional heat transfer mechanisms in the wall, bottom and around taphole(s) in operating furnaces is important for avoiding expensive repairs and to optimize production and extend campaign life. This paper describes a novel combination of two non-destructive techniques: stress wave analysis (Acousto Ultrasonic-Echo technology, AU-E) and heat transfer analysis using thermocouple measurements and cooling system data. This method allows for a more accurate prediction of the wear profile of the hearth while in operation. In this combined method, a 2D or 3D model of the hearth is created using the AU-E measurements and past thermal data. Thermal readings in a specific region of interest are used as objectives simultaneously in an iterative optimization procedure to produce a skull and/or future wear profile which more accurately represents the temperatures recorded from the hearth wall and bottom. This combined approach is used throughout the furnace life to estimate wear profiles and make important decisions regarding the furnace operations. Several applications of this method for operating furnaces are presented.